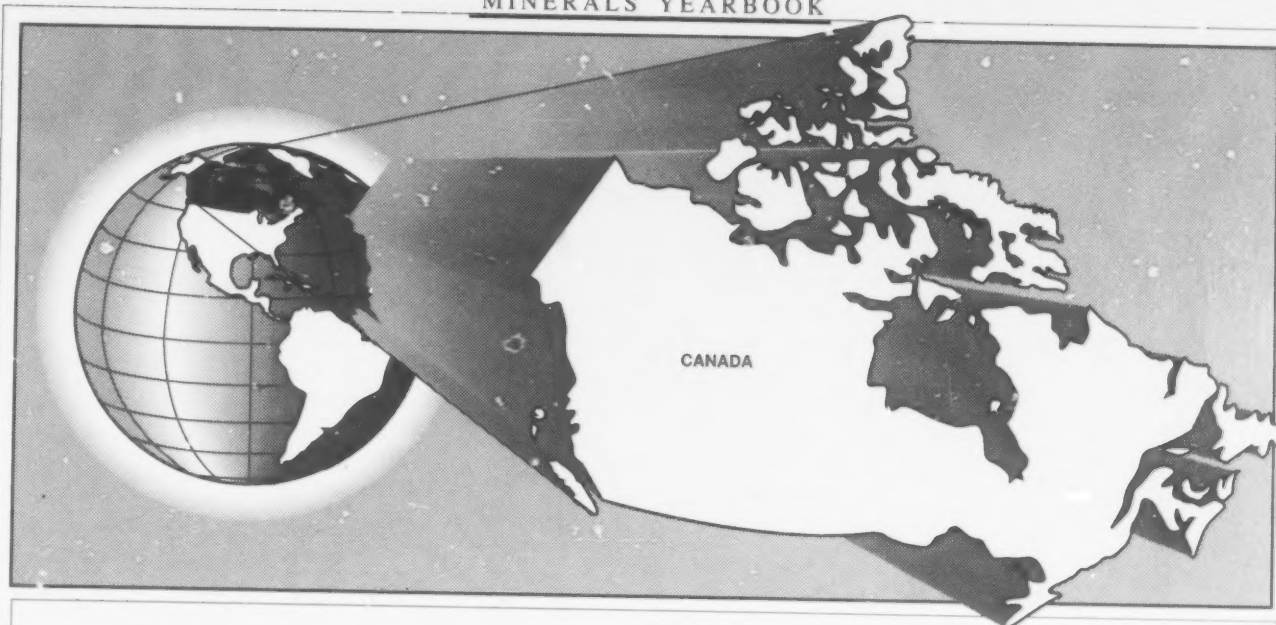


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MINERALS YEARBOOK



THE MINERAL INDUSTRY OF

CANADA

By Alfredo C. Gurmendi

1988

INTERNATIONAL REVIEW

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

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THE MINERAL INDUSTRY OF

CANADA



U.S.
DEPARTMENT
OF THE
INTERIOR

Manuel Lujan, Jr.
Secretary



BUREAU OF
MINES

T S Ary
Director

1988

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CANADA¹

By Alfredo C. Gurmendi²

INTRODUCTION

The Canadian mining industry made impressive gains in 1988. This strong momentum was expected to continue through 1989. Mining is a thriving industry within the Canadian economy. Canada is among the world's mining leaders, but mining is not its leading industry; it contributes 25% of the total value of Canada's exports. In 1988, mining employed about 392,000 workers, an increase of 6,000 workers from 1987.

Canada is a lower cost mineral producer with improved productivity, high-quality mineral deposits, and substantial byproduct values. As an innovative mineral seller, Canada combined strong prices for base metals and high volumes of output for nearly all mineral and metal commodities and benefited from the market recovery. However, the energy sector was bleaker because of the stronger Canadian dollar, reduction or phase-out of Government incentives for exploration and drilling, and sharply lower energy prices.

The gross domestic product improved about 4.2%. The Consumer Price Index increased about 4.2%. Financial results were affected adversely by the firming of the Canadian dollar from 75.41 U.S. cents in 1987 to 81.25 U.S. cents in 1988. The unemployment rate averaged 7.8%, which was the lowest unemployment rate since 1981.

GOVERNMENT POLICIES AND PROGRAMS

The Federal-Provincial Mineral Development Agreements (MDA) with Newfoundland, Nova Scotia, New Brunswick, Manitoba, Saskatchewan, Prince Edward Island, Yukon Territory, and the Northwest Territories entered the fifth and final year in 1988. These MDA's could be extended, but no decision on an extension had been made yet. The

MDA's with Quebec, Ontario, and British Columbia are to end in 1990.

Geological data bases generated under the Canada-Newfoundland MDA provided geologists with high potential target areas and improved understanding of gold environments in the Province.

The Canada-Nova Scotia MDA provided, in addition to geoscience projects, market, and feasibility and mineral commodity studies that were well received by the industry.

In New Brunswick, exploration interest was dominated by gold and was spurred by the availability of geological data produced under the Canada-New Brunswick MDA. Reports included studies on mineral aggregates, offshore mining, peat moss markets, and an evaluation of industrial minerals markets in the east coast area of the United States.

In Quebec, more than \$20 million³ was invested under the Canada-Quebec MDA in projects covering geoscience, mineral exploration, and infrastructure and feasibility studies to produce magnesium metal from asbestos tailings.

The \$30 million Canada-Ontario MDA was in the fourth of 5 years. More than 250 projects were in progress or had been completed at yearend. Reports and maps produced under this MDA have been a major factor in increased exploration. Studies on backfill techniques and bulk mining at depth have led to reduced underground mining costs and increased safety and productivity, which were quite well received, particularly by the nickel industry.

An estimated \$50 million in exploration activities resulted from the 5-year \$24.7 million Canada-Manitoba MDA, which entered its fifth and final year in 1988.

The \$6.38 million Canada-Saskatchewan MDA research and development programs, in cooperation with the Saskatchewan Potash Producers Association, contributed to the prevention of brine flow and to improved separation methods applicable in new or modified potash-processing plants.

The 5-year Canada-British Columbia MDA will expire in March 1990. Work continued on geoscience projects, environmental impact studies, infrastructure projects, and industrial mineral projects. Early in 1988, the British Columbia Provincial government passed a new Mineral Tenure Act (MTA) to streamline the acquisition of placer rights and to reinforce environmental safeguards by increasing monitoring and inspection.

The Canada-Yukon MDA contributed geochemical surveys and research in placer methods leading to improved gold recoveries. The Yukon Government and native leaders met in December 1988 to resolve outstanding land claim issues in the Council for Yukon Indians. An agreement-in-principle was expected to be signed in 1989.

The National Transportation Act of 1987 and the Motor Vehicle Transport Act of 1987 became effective on January 1, 1988. Both acts reduced shipping costs for the mineral industry.

The Free Trade Agreement (FTA) between the United States and Canada was to take effect on January 1, 1989. The agreement signals a new period in international trade when bilateral and regional (European Community) trade accords assume greater importance in setting the trends and rules of international commerce. The FTA was the culmination of more than 100 years of trade negotiations between the two countries to reduce tariffs. The FTA will give continuity to their trading relations. The elements of the FTA pertaining to minerals and metals include tariff elimination, creation of trading rules on services, rules on investment and energy, and the means to resolve trade disputes.

The Canadian exploration program, called flow through financing, allowed the tax credit for exploration expenditures to flow through to the shareholders of a corporation. The earned depletion allowance also flowed through to the investor. The introduction of the Mining Exploration Depletion Allow-

ance (MEDA) in 1983-84 had a dramatic impact on mine exploration and development. Exploration expenditures totaled \$513 million in 1986, \$1.09 billion in 1987, and about \$840 million in 1988. The program allowed the investor to deduct depletion in the year it was earned from income of any source.

The sale of flow-through shares has raised \$3 billion for exploration from 1983 to 1988. Where exploration was financed at least in part with flow-through shares, mineral deposits have either come into production since 1983 or are currently being prepared for production. At least 17 of the 25 new commitments in 1988 are for gold projects. During the 1975-87 period, emphasis on base metal projects declined from 62.6% of total mineral exploration expenditures in 1975 to 13% in 1987. Expenditures on exploration for precious metals (gold, silver, and platinum-group metals) increased from 6.7% in 1975 to 82% in 1987.

The new Canadian Exploration Incentive Program (CEIP) instituted on July 21, 1988, replaced MEDA as of January 1, 1989. Only those exploration expenditures that have been financed by flow-through shares will be eligible for CEIP. The program provides a Government grant equal to 30% of eligible exploration expenses up to \$8.4 million per year; the depletion allowance will be reduced to 16% beginning on January 1, 1990. The new CEIP was expected to reduce exploration activity, particularly when Canada has an urgent need of more exploration for copper, lead, zinc, and nickel to replenish its declining ore reserves.

PRODUCTION

The value of total mineral output, including metals, industrial minerals, and fuels, increased by almost 10% from 1987 to \$30.1 billion. According to the Canadian Department of Energy, Mines and Resources (EMR), the met-

als sector had an extraordinary performance with its output value reaching \$10.8 billion, an increase of 36%. The output value of industrial minerals grew to \$4.0 billion, an increase of 16%. The value of structural materials was \$2.3 billion, an increase of 9.5%. The total nonfuel sector value increased to \$15.7 billion, an increase of 29%. The value of fuels produced, excluding uranium, decreased by \$800 million or 12%, mainly as a result of lower oil prices. Nevertheless, this sector, which included oil, natural gas, natural gas byproducts, and coal, contributed \$14.5 billion or 48% of the total value of Canadian production. The dollar values of gold, uranium, lead, sulfur, oil, and natural gas byproducts were adversely affected by a combination of the decrease in market prices and by the firming of the Canadian dollar.

The 10 leading mineral commodities, based on value of output, were petroleum, natural gas, nickel, copper, gold, zinc, coal, natural gas byproducts, iron ore, and uranium. The text tables show the production values of the Provinces and Territories in billion dollars and the values of principal mineral production in million dollars.

Province or Territory	1987	1988 ^a
Alberta	12.9	12.1
Ontario	4.2	5.8
British Columbia	2.7	3.2
Saskatchewan	2.4	2.5
Quebec	2.1	2.2
Manitoba	.8	1.3
Northwest Territories	.7	.8
Newfoundland	.5	.7
New Brunswick	.5	.7
Yukon	.3	.4
Nova Scotia	.3	.4
Prince Edward Island	(^b)	(^b)
Total	27.4	30.1

^a Preliminary.

^b Less than 1/2 unit.

Source: Energy, Mines and Resources Canada, Ottawa, 1988.

Commodity	1987 ^a	1988 ^b
Metals:		
Nickel	960	2,646
Copper	1,450	1,883
Gold	1,663	1,800
Zinc	1,112	1,678
Iron ore	1,053	1,128
Uranium	891	900
Silver	320	307
Lead	298	271
Platinum-group	137	140
Molybdenum	95	88
Total¹	7,979	10,841
Industrial Minerals:		
Potash	562	860
Cement	752	823
Sand and gravel	580	636
Stone	440	488
Sulfur, elemental	394	375
Asbestos	179	218
Salt	180	210
Lime	127	154
Clay products	159	150
Gypsum	66	72
Sulfur in smelter gas	60	60
Total¹	3,499	4,046
Mineral Fuels:		
Petroleum, crude	9,156	7,597
Natural gas	3,480	4,041
Coal	1,238	1,550
Natural gas byproducts	1,415	1,308
Total¹	15,289	14,496

^a Preliminary. ^b Revised.

¹ Data may not add to totals shown because of independent rounding.

Source: Energy, Mines and Resources, Canada, Ottawa, 1988.

The Canadian minerals industry improved its performance as a result of reduced production costs, increased productivity, and higher commodity prices, especially for base metals.

New projects announced to be brought on-stream will require capital expenditure of more than \$610 million. One-half of this new investment will be for gold projects; 17 of the 25 new projects committed for production will be gold mines. Since 1977, 160 mineral deposits

TABLE 1
CANADA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988 ¹¹
METALS						
Aluminum:						
Alumina, gross weight	thousand tons	1,126	1,019	1,100	953	950
Metal:						
Primary		1,227,000	1,282,316	1,364,000	1,530,000	1,530,000
Secondary		64,000	65,000	68,000	69,000	59,000
Antimony ²		554	1,075	3,805	13,706	2,977
Bismuth ³		163	201	153	165	195
Cadmium ⁴		1,605	1,717	1,484	1,481	1,742
Calcium	kilograms	w	w	w	w	w
Cobalt:						
Mine output, Co content ⁵		2,325	2,067	2,486	2,490	2,764
Metal ⁶		2,213	2,023	1,990	2,200	2,200
Columbium and tantalum:						
Pyrochlore concentrate						
Gross weight		4,400	4,944	5,216	4,304	5,321
Cb content		1,987	2,223	2,340	1,937	2,357
Tantalite concentrate:						
Gross weight		—	—	—	—	91
Ta content		—	—	—	—	27
Copper:						
Mine output, recoverable Cu content ⁷		721,826	738,637	698,527	794,149	756,480
Metal, primary and secondary:						
Blister and anode		470,600	489,700	472,700	499,400	537,000
Refined		504,252	499,626	493,445	491,178	528,723
Gold	thousand troy ounces	2,683	2,815	3,308	3,724	4,110
Iron and steel:						
Iron ore: ⁸						
Gross weight	thousand tons	39,930	39,502	36,167	37,702	38,742
Fe content	do.	25,156	24,847	22,785	23,658	24,300
Metal:						
Pig iron	do.	9,643	9,665	9,249	9,500	9,500
Ferroalloys	do.	216	227	240	260	260
Steel, crude	do.	14,715	14,600	14,100	14,700	14,500
Lead:						
Mine output, Pb content		264,301	284,600	349,281	413,685	368,444
Metal, refined:						
Primary		173,000	173,220	169,934	139,475	179,461
Secondary		79,000	68,384	87,746	91,186	89,863
Lithium: Spodumene ⁹		1,300	1,460	7,500	11,500	14,000
Magnesium metal, primary ¹⁰		8,000	7,000	7,000	7,000	7,000
Molybdenum		11,557	7,852	11,251	14,771	12,388
Nickel:						
Mine output, Ni content ¹⁰		173,725	169,971	163,639	189,086	198,960
Metal, plant production ¹¹		111,591	108,041	111,279	131,500	151,300

See footnotes at end of table

TABLE 1—Continued
CANADA: PRODUCTION OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988 ²
METALS—Continued					
Platinum-group metals troy ounces	333,363	338,676	391,917	433,681	368,386
Selenium, refined ¹² kilograms	463,000	361,000	354,000	300,000	300,000
Silver thousand troy ounces	42,655	38,484	34,979	44,207	44,094
Tellurium, refined ¹² kilograms	21,000	19,000	20,000	13,000	10,000
Tin, mine output, Sn content	217	120	2,450	3,390	3,300
Titanium					
Ilmenite, gross weight thousand tons	1,800	2,500	2,400	2,800	2,800
Sorel slag (80% TiO ₂) ¹³	726,000	844,000	850,000	925,000	1,025,000
Tungsten, mine output, W content	3,715	3,174	1,416	—	—
Uranium oxide (U ₃ O ₈)	12,113	12,312	13,564	15,560	15,130
Zinc					
Mine output, Zn content	1,207,098	1,172,200	1,290,765	1,504,412	1,351,664
Metal, refined, primary	683,156	692,418	570,981	609,909	703,206
INDUSTRIAL MINERALS					
Asbestos thousand tons	837	750	662	665	705
Arsenic trioxide ¹⁴	3,000	3,000	3,000	2,000	2,000
Baite	64,197	71,049	40,000	42,000	54,000
Cement, hydraulic ¹⁵ thousand tons	9,240	10,192	10,602	12,590	12,611
Clays and clay products ¹⁶ value, thousands	\$100,200	\$138,246	\$180,353	\$159,000	\$150,600
Diatomite ¹⁷	4,000	3,800	4,100	4,200	4,200
Gypsum and anhydrite thousand tons	7,756	8,447	8,803	9,094	8,522
Lime do	2,266	2,212	2,243	2,330	2,535
Magnesite, dolomite, brucite	69,000	136,000	144,000	150,000	150,000
Mica, scrap and flake	10,881	11,503	12,000	13,500	12,000
Nepheline syenite	521,000	467,000	469,000	500,000	500,000
Nitrogen, N content of ammonia	3,493,464	3,620,286	3,540,000	3,511,719	4,010,161
Potash, K ₂ O equivalent thousand tons	7,527	6,661	6,752	7,668	8,070
Pyrite and pyrrhotite, gross weight ¹⁸	5,000	6,000	6,000	5,000	5,000
Salt thousand tons	10,235	10,085	10,332	10,129	10,975
Sand and gravel do	233,759	256,183	257,971	278,550	276,100
Silica (quartz)	2,624	2,669	2,640	2,560	2,600
Sodium compounds, n.e.s.					
Sodium carbonate ¹⁹	365,000	350,000	350,000	325,000	325,000
Sodium sulfate, natural ¹²	389,000	366,000	371,000	342,000	310,000
Stone ¹⁸ thousand tons	81,754	86,632	97,602	113,300	112,400
Sulfur					
Elemental byproduct					
Of smelter gases do	875	822	758	723	820
Of sour natural gas do	5,260	5,306	6,966	5,809	5,915
Of refineries ²⁰ do	165	174	189	190	200
Of tar sands do	296	392	435	426	400
Talc, soapstone, pyrophyllite	126,000	127,000	123,000	141,000	140,000
MINERAL FUELS AND RELATED MATERIALS					
Carbon black	176,543	173,022	154,418	160,300	160,697
Coal					
Bituminous and subbituminous	47,510,000	51,000,000	48,700,000	51,200,000	57,500,000
Lignite	9,918,000	9,672,329	8,281,312	10,000,000	12,000,000

See footnotes at end of table

TABLE 1—Continued
CANADA: PRODUCTION OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity		1984	1985	1986	1987	1988 ²
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coke, high-temperature		4,900,478	4,683,770	4,552,600	4,636,629	4,663,000
Gas, natural:						
Gross	million cubic feet	3,173,708	3,250,000	3,214,000	3,525,000	3,896,000
Marketed	do	2,505,818	2,831,200	2,695,680	2,844,700	3,144,100
Natural gas liquids:						
Gross:						
Butane	thousand 42-gallon barrels	30,492	20,068	18,733	*20,000	20,000
Propane	do	37,322	32,656	31,288	*30,000	30,000
Pentanes plus	do	34,513	36,654	36,932	*36,000	40,000
Ethane	do	35,765	34,664	32,444	*30,000	30,000
Condensate	do	1,057	1,043	828	*900	1,000
Total	do.	139,149	125,085	120,225	*116,900	121,000
Peat		541,000	643,000	738,000	648,000	708,000
Petroleum:						
Crude ¹⁰	thousand 42-gallon barrels	526,350	538,200	538,000	560,000	584,000
Refinery products:						
Gasoline						
Aviation	do	1,297	1,131	2,214	*1,600	2,200
Other	do	203,797	203,793	201,115	*202,000	200,000
Jet fuel	do	26,434	27,707	30,660	*30,000	30,000
Kerosene	do	13,831	13,573	14,235	*14,000	14,000
Distillate fuel oil, diesel and light	do	145,497	140,334	143,810	*135,000	140,000
Residual fuel oil, heavy	do	54,723	44,240	41,975	*40,000	40,000
Lubricants	do	5,808	5,755	6,205	*6,000	6,000
Liquefied petroleum gas, propane and butane	do	21,041	20,421	27,375	*18,000	27,000
Petrochemical feedstocks	do	27,527	27,595	37,836	*34,000	35,000
Asphalt	do	16,108	18,236	19,286	*18,000	19,000
Petroleum coke	do	30,922	41,244	35,929	*32,000	30,000
Unspecified	do					
Refinery fuel and losses	do	12,823	24,872	35,215	*30,000	30,000
Total	do.	559,808	568,901	593,855	*560,600	573,200

* Estimated. ² Preliminary. ³ Revised. W Withheld to avoid disclosing company proprietary data.

¹ Table includes data available through May 1989.

² So content of antimonial lead alloys, flue dust, and dore slag estimated on the basis of reported gross production.

³ Refined metal and bullion from domestic ores plus recoverable Bi content of exported concentrates.

⁴ Refined metal from domestic ores plus recoverable Cd content of exported ores and concentrates.

⁵ Actual output not reported. Data represent the Co content of all products derived from ores of Canadian origin, including nickel oxide sinter shipped to the United Kingdom and nickel-copper-cobalt matte shipped to Norway for further processing.

⁶ Actual output not reported. Data represent the output within Canada of metallic cobalt from ores of both Canadian and non-Canadian origin.

⁷ Blister copper from domestic ores plus recoverable Cu content of exported matte and concentrates.

⁸ Series represent gross weight and metal content of usable iron ore as mine shipments.

⁹ Based on all of Canada's spodumene concentrates (Tantalum Mining Corp. of Canada Ltd.'s Inco property).

¹⁰ Refined nickel from domestic ores plus recoverable Ni content of exported matte.

¹¹ Includes metallic nickel, nickel oxide, Incomet, nickel powder and pellets, utility nickel, nickel carbonate, and nickel residue.

¹² From all sources, including imports and secondary sources.

¹³ Refined selen slag contained 80% TiO₂ in 1984-88.

¹⁴ Refined arsenic (As₂O₃) from Nerc's Con Mine in Yellowknife, Northwest Territories.

¹⁵ Cement shipped and/or used by producers.

¹⁶ Includes bentonite products from common clay, fire clay, stoneware clay, and other clays.

¹⁷ Excludes byproduct production from chemical plants.

¹⁸ Crushed, building, ornamental, paving, and similar stone.

¹⁹ Including synthetic crude (from oil shale and/or tar sands).

with promising production potential have been discovered. In 1977, only 1 promising deposit out of 10 was a gold deposit; in 1988, 9 out of 10 were gold deposits.

TRADE

The Free Trade Agreement (FTA) between the United States and Canada, signed on January 2, 1988, was the major trade event of the year. The agreement was the central issue of a parliamentary election in November 1988 and was ratified by the Canadian Senate in December 1988.

The FTA was intended to eliminate tariffs and to substantially reduce other impediments to bilateral trade in goods and services between the United States and Canada within 10 years. The FTA agreement was planned to promote fair competition and liberalize trade in several areas, including agricultural, automobiles, energy, financial services, and Government procurement; liberalize conditions for investment; establish effective administrative procedures and lay the foundation for further bilateral and multilateral cooperation.

The FTA, effective on January 1, 1989, specified phasing out tariffs on metals and industrial minerals trade between the two countries over a 5- to 10-year period (see the FTA tariffs schedule). In 1988, about 70% of all Canadian goods and 85% of minerals and mineral products entered the United States duty free.

The FTA does not eliminate subsidies on either side of the border. It called for a 5-year study of subsidies, which can be extended 2 years for negotiations. In the meantime, anti-dumping and countervailing duty-trade laws in both countries would remain in effect.

More than 70% of Canada's exports entered the United States, although 22% of U.S. exports went to Canada. About one-third of the 1988 bilateral

Commodity	Existing tariffs ¹ (percent)		Phaseout
	Canada	United States	
METALS			
Chromium	10.2	3.7	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Cobalt	10.2	5.5	Do.
Columbium (niobium)	4.0	4.9	Do.
Copper			
Refined	10.3	1.0	Do.
Alloys	10.2	1.0	10-year elimination starting Jan. 1, 1989; 10% reduction per year.
Ferroalloys			
Ferromolybdenum	10.2	4.5	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Ferro-silicon chromium	10.2	10.0	Immediate lifting of tariffs on Jan. 1, 1989.
Ferrotitanium	10.2	3.7	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Ferrotungsten and ferrosilicon tungsten	10.2	5.6	Do.
Ferrovanadium	10.2	4.2	Do.
Minor metals			
Beryllium, waste and scrap	10.2	8.5	Do.
Germanium, unwrought	10.2	3.7	Do.
Magnesium containing at least 99.8% by weight of Mg	4.0	8.0	10-year elimination starting Jan. 1, 1989; 10% reduction per year.
Lead			
Refined (metal content)	10.2	3.5	Do.
Oxide	12.5	15.0	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Rare-earth metals	12.5	3.7	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Vanadium	10.2	3.0	Do.
Zinc			
Refined	—	1.5	10-year elimination starting Jan. 1, 1989; 10% reduction per year.
INDUSTRIAL MINERALS			
Granite, cut	5.5	4.2	5-year elimination starting Jan. 1, 1989; 20% reduction per year.
Graphite, powder	9.2	—	Do.
Gypsum, wallboard	9.4	2.4	10-year elimination starting Jan. 1, 1989; 10% reduction per year.

¹ Tariff rates under the General Agreement on Tariffs and Trade (GATT).

TABLE 2
**CANADA: RELATIVE
IMPORTANCE OF MINERAL
PRODUCTION IN 1988, BY
COMMODITY**
(Percent)

Commodity	Share of total value ^a
Petroleum, crude	25.2
Natural gas	13.4
Nickel	8.8
Copper	6.2
Gold	6.0
Zinc	5.6
Coal	5.1
Natural gas byproducts	4.3
Iron ore	3.7
Uranium	3.0
Potash	2.9
Cement	2.7
Sand and gravel	2.1
Others	11.0
Total	100.0

^a Preliminary

Source: Energy, Mines and Resources Canada, Ottawa, 1988.

trade, valued at \$150 billion, was freely exchanged. Reducing restrictions on the rest was expected to make both economies more efficient. The Economic Council of Canada, a research organization of the Federal Government, forecast that by 1998 free trade would bring a net gain of 251,000 jobs to Canada, increasing employment by almost 2% and Canada's gross national product by 2.5%. The U.S. Department of Commerce estimated that the elimination of tariffs alone would result in a \$25 billion increase in trade between the two countries over a 5-year period, with more than 14,000 new U.S. jobs created.

U.S. exports to Canada amounted to \$69.2 billion, of which \$2.9 billion was mineral related. U.S. imports from Canada amounted to \$80.9 billion, of which \$15.1 billion was composed of metals, metal products, oil, and natural gas.

COMMODITY REVIEW

Metals

Aluminum.—The Canadian aluminum industry benefited from higher prices, cheap hydroelectric power, lower operating costs, and increased productivity. The stabilization of inventories, expectations of additional production from smelter projects to be completed in 1991, and labor agreements caused prices to moderate toward yearend. Production of primary aluminum decreased 1% although shipments of aluminum to the United States increased 11% to a new level of 893,000 tons.

At yearend, Canadian smelters were operating at full capacity, with the exception of Alcan Aluminium Ltd.'s Arvida plant in Jonquière, Quebec, which operated at 88% of its 432,000-ton capacity.

In 1988, as a result of a favorable climate for the aluminum industry in Canada and firm worldwide demand, Alcan reported a record high net income of \$931 million, an increase of \$498 million from 1987.

Two important projects were undertaken to ensure Alcan's position as the lowest cost aluminum producer in the world. Construction began on a new 200,000-ton-per-year smelter at Laterrière, Quebec. The new smelter was projected to cost \$600 million and will replace part of the Soderbeg facility at the Arvida smelter. It will result in a 60% reduction in polycyclic aromatic hydrocarbon (PAH) emissions and appreciable savings in energy and labor. Production from the first of four 50,000-ton-per-year potlines was expected to begin in 1989. The project will be completed in 1991. Alcan also announced that expansion of the Kemano, British Columbia, hydroelectric plant will begin in 1989. The additional capacity of 520 megawatts in the Kemano plant will cost \$480 million. When the plant expansion is completed in 1994, Alcan planned to sell surplus power to BC Hydro & Power Authority,

the Provincially owned utility.

Construction has begun on a \$30 million facility at Jonquière, Quebec, for production of 12,000 tons per year of aluminum and ceramic composites which offer superior strength and stiffness at a low cost.

Aluminerie de Bécancour announced in late 1988 that it would proceed with a 120,000-ton-per-year expansion of its smelter in Quebec, beginning in May 1989. This expansion was projected to cost \$550 million. Total expenditure will amount to \$1.4 billion and the work force will increase from 775 to 1,000 employees. Initial production from the 360,000-ton-per-year expanded facility was expected to start in January 1991.

A consortium of Société Générale de Financement du Québec (SGF), Reynolds Metals Co., Austria Metal AG, Mitsubishi Metal Corp., Kobe Steel Ltd., and Yoshida Kogyo KK Quebec, undertook a feasibility study for a new 270,000-ton-per-year aluminum smelter at Sept-Îles, Quebec.

In Manitoba, Alumax Inc. and the Provincial government held discussions for the possible establishment of a new smelter. According to Alumax, Manitoba was just one of several possible locations including sites in Quebec, British Columbia, Iceland, and Venezuela.

Connecticut Metal Industries Inc. of the United States and Exalloy Metals of Canada announced, in October 1988, that they would construct a pilot plant in Toronto, Ontario, to recycle plastic-coated aluminum scrap. The facility was expected to process 90 metric tons per month. Environmental protection remained a high priority in the facility's current operations and planned investments.

Copper.—The price of copper on the London Metal Exchange (LME) increased late in 1988 because of labor strikes in Peru, strong world demand, and falling inventories. The average LME price was \$1.18 per pound. Canadian copper producers benefited

TABLE 3
CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1986 ¹	1987	Destinations, 1987	
			United States	Other (principal)
METALS				
Aluminum				
Ore and concentrate	45,434	45,625	38,327	United Kingdom 2,900; West Germany 2,027
Metal including alloys				
Scrap	125,019	127,181	107,601	Japan 16,315; United Kingdom 868
Unwrought	1,163,875	1,171,888	859,301	NA
Semimanufactures	59,953	98,448	82,924	Belgium-Luxembourg 8,405; Bahrain 1,382
Cadmium Metal including alloys, all forms ²	1,383	1,157	875	United Kingdom 175; Netherlands 80
Cobalt Oxides and hydroxides	374	440	—	All to United Kingdom
Copper				
Ore and concentrate, Cu content	341,392	381,123	221	Japan 273,535; China 25,861; Republic of Korea 15,980
Metal including alloys				
Scrap	70,755	72,102	56,003	West Germany 3,315; Republic of Korea 2,311
Unwrought	306,891	288,811	197,815	United Kingdom 39,381; Sweden 9,620
Semimanufactures	50,962	58,596	48,469	India 1,954; Venezuela 1,613
Gold ³				
Ore and concentrate, Au content troy ounces	234,764	276,689	1,286	Japan 200,524; West Germany 23,952; Belgium-Luxembourg 13,664
Metal including alloys, unwrought and partly wrought thousand troy ounces	5,321	2,245	1,464	Japan 460; Belgium-Luxembourg 231
Iron and steel				
Iron ore and concentrate				
Excluding roasted pyrite thousand tons	30,995	29,662	8,861	United Kingdom 7,045; West Germany 3,032
Pyrite, roasted	34,722	16,896	16,896	
Metal				
Scrap thousand tons	921	1,087	777	Republic of Korea 118; Thailand 42
Pig iron, cast iron, related materials	556,610	500,355	223,302	Netherlands 183,822; Spain 29,866
Ferroalloys				
Ferromanganese	45,132	23,103	23,048	Japan 55
Unspecified	57,842	38,362	26,466	Japan 7,901; United Kingdom 1,872
Steel, primary forms	233,426	104,756	91,536	Turkey 12,191; Netherlands 643
Semimanufactures				
Bars, rods, angles, shapes, sections	1,074,692	1,053,616	1,032,283	Thailand 7,656; Mexico 2,610
Universals, plates, sheets	1,486,148	1,755,533	1,443,324	Thailand 88,319; Mexico 34,147
Rails and accessories	103,586	189,457	40,974	Mexico 69,002; India 24,766
Wire	193,888	195,376	193,382	Republic of South Africa 300; New Zealand 207
Tubes, pipes, fittings	367,048	492,356	484,108	Pakistan 1,605; United Kingdom 1,257

See footnotes at end of table

TABLE 3—Continued
CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1986 ¹	1987	Destinations, 1987		
			United States	Other (principal)	
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Castings and forgings, rough	120,804	139,142	138,336	United Kingdom 272; West Germany 189	
Lead					
Ore and concentrate, Pb content	118,375	207,938	8,607	Japan 64,165; Belgium-Luxembourg 52,259; Australia 29,283	
Metal including alloys					
Scrap	25,564	21,970	4,264	Brazil 11,881; West Germany 1,051	
Unwrought	111,853	100,207	62,994	United Kingdom 19,423; Italy 5,959	
Semimanufactures	23,225	23,583	16,236	Brazil 4,108; Japan 1,117	
Magnesium: Metal including alloys, semi-manufactures	4,767	4,627	988	United Kingdom 1,134; Japan 1,076	
Nickel					
Ore and concentrate including matte, Ni content ²	57,780	56,558	—	Norway 30,798; United Kingdom 25,760	
Oxides, Ni content ²	13,917	20,715	NA	NA	
Metal including alloys					
Scrap	6,252	7,663	4,607	Finland 1,082; Netherlands 839	
Unwrought	86,057	96,165	—	NA	
Semimanufactures	10,880	14,818	11,196	Japan 1,233; Netherlands 419	
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	\$22,717	\$23,981	\$7,706	United Kingdom \$13,134; Singapore \$1,614	
Silver					
Ore and concentrate ³	do.	\$185,210	\$243,636	\$3,031	Japan \$114,555; United Kingdom \$71,327; Belgium-Luxembourg \$15,189
Waste and sweepings ³	do.	\$82,353	\$95,475	\$64,736	United Kingdom \$15,270; West Germany \$12,041
Metal including alloys, unwrought and partly wrought	do.	\$233,906	\$124,144	\$122,565	Singapore \$737; France \$320
Tin					
Ore and concentrate, Sn content		3,725	2,783	55	United Kingdom 2,422; Mexico 216; Malaysia 90
Titanium: Metal including alloys, all forms ²					
Uranium and thorium: Ore and concentrate value, thousands	\$120,217	\$209,843	\$171,011		United Kingdom \$19,480; France \$18,070
Zinc					
Ore and concentrate, Zn content	450,252	613,180	33,792		Belgium-Luxembourg 259,161; Japan 111,249; Italy 47,822
Metal including alloys					
Unwrought	427,175	441,220	342,968		United Kingdom 26,154; China 10,482
Semimanufactures	5,103	8,909	5,140		Hong Kong 2,367; China 577

See footnotes at end of table

TABLE 3—Continued
CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986*	1987	Destinations, 1987	
			United States	Other (principal)
METALS—Continued				
Other				
Ores and concentrates	166,610	130,366	13,790	Italy 59,430; West Germany 20,097; Japan 16,854
Ashes and residues	47,798	59,748	25,101	Japan 7,282; West Germany 3,440
Base metals including alloys, all forms	2,915	2,565	1,731	United Kingdom 332; Belgium-Luxembourg 127
INDUSTRIAL MINERALS				
Abrasives, n.e.s.				
Natural: Corundum, emery, pumice, etc.	265	1,388	1,384	NA
Artificial:				
Corundum	127,552	139,926	129,101	United Kingdom 10,105; West Germany 490
Silicon carbide value, thousands	\$52,225	\$66,263	\$60,062	Japan \$1,694; West Germany \$931
Dust and powder of precious and semiprecious stones do	\$204	\$507	\$507	
Grinding and polishing wheels and stones do	\$6,297	\$8,363	\$7,189	West Germany \$315; New Zealand \$222
Asbestos, crude	717,703	648,843	84,223	Japan 87,321; Thailand 34,411
Bastite and witherite	6,627	6,052	5,852	Madagascar 200
Cement value, thousands	\$141,571	\$146,984	\$145,860	Cuba \$331; United Kingdom \$172
Clays, crude	2,269	6,868	2,060	Finland 4,130; West Germany 259
Diamond				
Gem, not set or strung value, thousands	\$22,914	\$27,443	\$13,393	Israel \$7,250; Belgium-Luxembourg \$5,291
Industrial stones do	\$550	\$336	\$270	Belgium-Luxembourg \$27; Ireland \$27
Feldspar, fluorspar, related materials	338,260	356,144	318,743	Netherlands 21,028; Australia 6,017
Fertilizer materials				
Manufactured:				
Ammonia thousand tons	930	1,317	1,269	Philippines 12; Republic of South Africa 12
Nitrogenous do	1,740	1,923	1,440	China 159; Australia 75
Phosphatic	21,879	34,979	29,596	Philippines 5,018; New Zealand 75
Potassic thousand tons	9,894	10,984	6,029	China 794; Brazil 654
Unspecified and mixed do	257	243	214	Jamaica 10; Portugal 8
Gypsum and plaster	5,942,849	5,723,359	5,723,176	Comoros 143; West Germany 21
Lime	189,693	163,777	163,637	Bermuda 99; Australia 34
Magnesium compounds: Magnesite, crude value, thousands	\$29,913	\$24,847	\$20,563	West Germany \$987; Mexico \$631
Pigments, mineral: Iron oxides and hydroxides, natural and processed	16,216	17,532	17,373	Brazil 106; Philippines 25
Precious and semiprecious stones other than diamond, synthetic value, thousands	\$10,262	\$9,072	\$5,915	United Kingdom \$455; Belgium-Luxembourg \$392
Salt and brine thousand tons	2,553	1,960	1,955	St. Pierre and Miquelon 2; Barbados 1

See footnotes at end of table.

TABLE 3—Continued

CANADA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1986 ¹	1987	Destinations, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Sodium compounds, n.e.s.: Sulfate, natural ²	233,390	168,095	150,840	New Zealand 17,113; unspecified 142
Stone, sand and gravel				
Dimension stone:				
Crude and partly worked	400,399	874,273	812,387	Jamaica 29,711; Cuba 10,675
Worked value, thousands	\$22,700	\$24,569	\$20,463	Japan \$2,883; United Kingdom \$529
Dolomite, chiefly refractory-grade	728,722	506,746	506,746	
Limestone other than dimension	1,350,344	1,709,508	1,709,501	United Kingdom 7
Quartz and quartzite	88,394	60,681	60,681	
Sand other than metal-bearing	249,879	414,849	392,393	Cuba 22,232; France 128
Sulfur:				
Elemental, crude including native and byproduct thousand tons	6,257	6,572	766	Morocco 1,366; Brazil 547
Sulfuric acid	755,651	804,395	804,347	St. Christopher and Nevis 27; Mexico 18
Other: Slag and dross, not metal-bearing value, thousands	\$169,377	\$171,580	\$48,018	West Germany \$35,115; France \$35,054
MINERAL FUELS AND RELATED MATERIALS				
Coal:				
Briquets of anthracite and bituminous coal	13	75	75	
All grades excluding briquets thousand tons	25,900	25,466	278	Japan 16,625; Republic of Korea 3,766; Brazil 1,182
Coke and semicoke	108,807	152,245	148,758	Norway 3,487
Peat including briquets and litter	535,129	477,507	436,604	Japan 35,113; United Kingdom 3,426
Petroleum:				
Crude thousand 42-gallon barrels	211,245	224,816	223,226	Japan 886; unspecified 704
Refinery products:				
Liquefied petroleum gas do.	168,571	214,008	213,974	Mexico 30; St. Pierre and Miquelon 3
Gasoline, motor do.	13,103	12,720	11,742	Japan 948; St. Pierre and Miquelon 26
Distillate fuel oil do.	22,660	30,109	27,912	Japan 885; Republic of Korea 412
Lubricants do.	544	435	414	Hong Kong 2; St. Pierre and Miquelon 2
Residual fuel oil do.	8,279	7,034	7,034	
Asphalt do.	(³)	—	—	
Bituminous mixtures do.	1,493	1,753	1,744	United Kingdom 4; Gambia 3

¹ Revised. NA Not available.² Table prepared by H. D. Willis.³ Energy, Mines and Resources Canada.⁴ May include other precious metals.⁵ Reclassified as bituminous mixtures.

TABLE 4
CANADA: IMPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1986 ¹	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and rare-earth metals, unspecified	3,900	9,542	9,432	United Kingdom 96; Brazil 9
Aluminum:				
Ore and concentrate thousand tons	2,113	2,019	69	Guinea 493; Brazil 434; Guyana 363
Oxides and hydroxides do.	1,744	2,096	490	Australia 893; Jamaica 503
Metal including alloys:				
Scrap	67,668	53,691	53,653	West Germany 38
Unwrought	64,461	53,480	48,314	United Arab Emirates 1,224; Brazil 910
Semimanufactures	173,561	207,342	175,937	France 9,471; Belgium-Luxembourg 6,255
Antimony Oxides ²	1,278	1,526	551	United Kingdom 809; Belgium-Luxembourg 96
Beryllium Metal including alloys, all forms value, thousands	\$615	\$375	\$356	West Germany \$18
Chromium:				
Ore and concentrate, Cr content	15,975	13,546	6,117	Philippines 4,059; Republic of South Africa 1,187
Oxides and hydroxides	2,476	2,978	1,304	West Germany 845; United Kingdom 456
Cobalt Oxides and hydroxides	31	38	17	United Kingdom 9; Finland 7
Columbium and tantalum Metal including alloys:				
Tantalum value, thousands	\$292	\$1,167	\$968	Japan \$119; France \$80
Copper:				
Ore and concentrate, Cu content	53,148	45,153	5,881	Chile 18,836; Indonesia 8,076; Peru 6,881
Matte and speiss, Cu content	1,996	1,346	920	Italy 426
Metal including alloys:				
Scrap	65,768	69,322	65,127	Finland 3,505; France 349
Unwrought	20,770	16,087	4,562	Zaire 11,506; Chile 17
Semimanufactures	40,347	51,681	37,851	West Germany 2,737; Japan 2,633
Gold ² :				
Ore and concentrate, Au content troy ounces	22,827	34,112	2,636	Peru 11,735; Chile 8,456; Indonesia 7,330
Metal including alloys, unwrought and partly wrought thousand troy ounces	3,702	1,927	1,511	Uruguay 206; Nicaragua 65
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	5,367	5,213	4,905	Brazil 308
Metal:				
Scrap do.	750	779	777	Bermuda 1
Pig iron, cast iron, related materials	18,063	16,123	16,109	United Kingdom 8; West Germany 3
Ferroalloys:				
Ferrochromium ²	39,045	44,121	14,117	Republic of South Africa 25,475; Finland 1,816
Ferromanganese	20,283	39,607	4,944	Norway 13,200; Republic of South Africa 5,928; Mexico 5,230

¹See footnotes at end of table.

TABLE 4—Continued
CANADA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986 ¹	1987	Sources, 1987		
			United States	Other (principal)	
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys—Continued					
Ferrovandium ²	162	205	183	Austria 17; West Germany 5.	
Unspecified	34,453	40,762	20,848	Republic of South Africa 5,997; Brazil 5,583.	
Steel, primary forms	255,465	726,754	48,157	United Kingdom 246,225; Netherlands 155,632; Brazil 145,147.	
Semimanufactures:					
Bars, rods, angles, shapes, sections	614,814	679,662	188,670	Spain 110,030; Brazil 65,068.	
Universals, plates, sheets	875,091	919,406	271,443	West Germany 154,354; United Kingdom 100,746.	
Hoop and strip	39,124	42,121	33,726	West Germany 4,759; Japan 1,104.	
Rails and accessories	83,111	67,007	5,134	Japan 50,105; Belgium-Luxembourg 5,111.	
Wire	60,536	61,683	19,714	Belgium-Luxembourg 9,483; France 8,132.	
Tubes, pipes, fittings	154,578	166,775	64,473	Japan 33,434; United Kingdom 11,583.	
Castings and forgings, rough	33,914	42,866	38,881	Italy 871; France 850.	
Lead:					
Ore and concentrate, Pb content	38	158	127	Chile 31.	
Oxides	2,148	5,524	5,157	Mexico 182; Republic of South Africa 162.	
Metal including alloys:					
Scrap	61,530	74,152	73,821	Australia 281; United Kingdom 50.	
Unwrought	4,309	12,600	6,075	Mexico 4,317; Japan 1,299.	
Semimanufactures	545	1,342	1,277	Denmark 38; United Kingdom 25.	
Magnesium: Metal including alloys:					
Scrap	378	173	173		
Unwrought	3,146	2,742	2,563	France 124; Norway 55.	
Semimanufactures	value thousands	\$9,047	\$13,791	\$10,655	Norway \$2,405; France \$647.
Manganese:					
Ore and concentrate:					
Metallurgical-grade, Mn content	95,205	81,133	3,965	Gabon 25,078; Comoros 23,762; Republic of South Africa 12,444.	
Oxides	6,027	5,399	3,854	Japan 1,245; Netherlands 117.	
Mercury	76-pound flasks	2,234	957	957	
Molybdenum: Metal including alloys, all forms					
	value, thousands	\$1,485	\$1,023	\$767	Austria \$130; West Germany \$73.
Nickel:					
Ore and concentrate, Ni content	1,094	3,092	2,837	East Germany 188; United Kingdom 15.	
Matte and speiss, Ni content	8,273	2,792	—	All from Australia.	

See footnotes at end of table.

TABLE 4—Continued
CANADA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986 ¹	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Nickel—Continued				
Metal including alloys:				
Scrap	28,964	17,647	7,171	United Kingdom 6,485; Norway 2,244.
Unwrought	2,633	2,540	648	Norway 1,882; West Germany 8.
Semimanufactures	3,130	3,519	2,222	West Germany 929; United Kingdom 283.
Platinum-group metals: Metals including alloys, unwrought and partly wrought:				
Platinum value, thousands	\$26,954	\$28,005	\$20,437	United Kingdom \$5,372; U.S.S.R. \$2,174.
Silver:				
Ore and concentrate ³ do.	\$23,284	\$40,677	\$2,768	Peru \$17,264; Chile \$7,554.
Waste and sweepings ³ do.	\$451,173	\$234,748	\$226,666	United Kingdom \$2,579; France \$1,662.
Metal including alloys, unwrought and partly wrought do.	\$24,919	\$27,449	\$25,297	Chile \$1,964; West Germany \$89.
Tin:				
Ore and concentrate, Sn content	202	—	—	
Metal including alloys:				
Unwrought	3,881	3,767	1,765	Brazil 801; China 253.
Semimanufactures	132	89	78	Bolivia 10; Hong Kong 1.
Titanium:				
Ore and concentrate, Ti content ²	2,894	19,311	2,101	Australia 16,321; Norway 889.
Oxides	7,863	10,312	4,776	West Germany 4,152; France 365.
Metal including alloys ²	941	937	469	United Kingdom 403; Japan 66.
Tungsten:				
Ore and concentrate, W content	11	1	1	
Metal including alloys, all forms value, thousands	\$2,312	\$2,236	\$2,137	United Kingdom \$41; Belgium-Luxembourg \$24.
Uranium and thorium:				
Ore and concentrate do.	\$65,525	\$62,532	\$19,496	Australia \$26,714; Republic of South Africa \$6,365.
Metal including alloys, all forms do.	\$105	\$84	\$84	
Vanadium: Oxides ²	1,177	1,410	136	Republic of South Africa 1,168; China 66.
Zinc:				
Ore and concentrate, Zn content	29,468	26,015	16,231	Chile 7,686; Peru 2,081.
Oxides	1,628	2,229	2,082	Mexico 100; Netherlands 25.
Metal including alloys:				
Scrap	544	466	266	Belgium-Luxembourg 200.
Unwrought	7,440	11,031	4,664	Spain 3,000; Belgium-Luxembourg 1,304.
Semimanufactures	1,263	2,631	1,373	West Germany 1,215; Italy 26.
Other:				
Ores and concentrates, metal content ²	25,183	16,278	4,511	Peru 3,403; Australia 3,247.

See footnotes at end of table.

TABLE 4—Continued
CANADA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986 ^r	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Other—Continued				
Oxides and hydroxides	19,361	19,008	17,665	United Kingdom 644; Japan 157
Ashes and residues	36,021	26,019	25,638	United Kingdom 303; Chile 41
Base metals including alloys, all forms	value, thousands \$59,371	\$55,537	\$37,022	Zaire \$5,550; France \$5,130
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	27,927	28,386	24,430	Turkey 2,100; Ecuador 796
Dust and powder of precious and semiprecious stones	value, thousands \$2,105	\$2,217	\$1,749	U.S.S.R. \$404; Ireland \$46
Grinding and polishing wheels and stones	do. \$23,733	\$28,428	\$16,704	Italy \$4,693; West Germany \$2,489
Asbestos, crude	325	237	227	Zimbabwe 10
Barite and witherite	10,525	4,660	3,672	Netherlands 901; China 87
Boron materials:				
Crude natural borates	value, thousands \$460	\$585	\$582	Hong Kong \$3
Oxides and acids	5,148	4,620	4,221	Italy 375; Japan 20
Cement	439,957	586,152	356,720	Spain 115,801; Greece 61,106
Chalk	value, thousands \$711	\$1,151	\$1,083	West Germany \$59; Belgium-Luxembourg \$9
Clays, crude	877,312	990,363	911,821	Greece 73,648; Italy 1,600
Cryolite and chiolite	3,537	8,607	1,045	Netherlands 7,332; Denmark 230
Diamond:				
Gem, not set or strung	value, thousands \$119,049	\$126,178	\$30,079	Belgium-Luxembourg \$49,731; Israel \$33,649
Industrial stones	do. \$6,776	\$9,579	\$8,130	Ireland \$1,293; United Kingdom \$71
Diatomite and other infusorial earth	26,338	24,483	24,483	
Feldspar, fluorspar, related materials	value, thousands \$16,642	\$13,839	\$2,059	Mexico \$5,764; Morocco \$2,421
Fertilizer materials:				
Crude, n.e.s.	20,190	24,200	23,675	West Germany 205; United Kingdom 193
Manufactured:				
Ammonia	26,775	13,672	13,648	Japan 20; West Germany 3
Nitrogenous	280,039	374,811	141,770	Netherlands 67,857; East Germany 55,204
Phosphatic	436,539	486,047	478,461	Israel 6,394; Belgium-Luxembourg 1,111
Potassic	53,385	64,283	64,111	Italy 132; West Germany 40
Unspecified and mixed	29,656	42,576	41,679	West Germany 316; United Kingdom 207
Graphite, natural	value, thousands \$2,143	\$2,727	\$2,279	Switzerland \$199; West Germany \$146
Gypsum and plaster	242,953	243,523	41,472	Mexico 118,461; Spain 83,327
Lime	46,916	44,289	42,268	Belgium-Luxembourg 2,021
Magnesium compounds: Magnesite, crude	46,782	73,017	41,119	Netherlands 10,091; Brazil 6,001

See footnotes at end of table.

TABLE 4—Continued
CANADA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity		1986 ¹	1987	Sources, 1987	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Mica:					
Crude including splittings and waste	value, thousands	\$592	\$568	\$568	
Worked including agglomerated splittings	do.	\$2,748	\$2,620	\$1,794	France \$369; India \$329.
Nitrates, crude		7,941	4,980	853	Chile 4,109; United Kingdom 18
Phosphates, crude	thousand tons	2,356	1,968	1,623	Togo 258; Morocco 73.
Pigments, mineral: Iron oxides and hydroxides, processed		8,484	11,886	9,483	West Germany 1,019; Spain 721.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	\$16,504	\$17,455	\$7,867	Thailand \$2,008; West Germany \$1,518.
Synthetic	do.	\$6,354	\$6,086	\$1,855	Austria \$2,217; West Germany \$736.
Pyrite, unroasted	do.	\$96	\$70	\$70	
Salt and brine	thousand tons	1,331	1,113	662	Mexico 341; Chile 53.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		1,087	1,143	1,143	
Sulfate, manufactured		55,226	52,216	16,711	United Kingdom 20,515; Norway 4,215.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		47,920	67,445	33,020	Republic of South Africa 18,061; Italy 4,014.
Worked	value, thousands	\$27,251	\$42,648	\$4,656	Italy \$30,293; Spain \$2,705.
Dolomite, chiefly refractory-grade		3,101	29,005	29,005	
Gravel and crushed rock		551,051	594,103	590,317	West Germany 1,540; Australia 1,295.
Limestone other than dimension	thousand tons	2,357	2,695	2,695	
Quartz and quartzite		349	515	368	Sweden 139; Brazil 7.
Sand other than metal-bearing	thousand tons	1,638	1,626	1,624	Australia 1; Philippines 1.
Sulfur:					
Elemental					
Crude including native and byproduct		10,760	24,711	24,690	West Germany 21.
Colloidal, precipitated, sublimed		31	151	59	Belgium-Luxembourg 80; West Germany 12.
Sulfuric acid		29,126	44,624	37,853	United Kingdom 6,696; Australia 33.
Talc, steatite, soapstone, pyrophyllite		39,488	49,711	48,978	Finland 218; United Kingdom 157.
Vermiculite ²		24,199	25,260	17,125	Republic of South Africa 8,135.
Other:					
Crude	value, thousands	\$12,964	\$16,704	\$15,403	Republic of South Africa \$969; France \$169.
Slag and dross, not metal-bearing		188,394	187,904	144,845	United Kingdom 81; Japan 3.

See footnotes at end of table.

TABLE 4—Continued
CANADA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986 ¹	1987	Sources, 1987	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	3,766	8,050	8,050	
Carbon black	24,762	12,851	12,542	West Germany 187; Mexico 45.
Coal:				
Briquets of anthracite and bituminous coal	251	172	172	
Lignite including briquets	10,397	9,388	9,388	
All grades excluding briquets	thousand tons 13,368	14,150	14,136	Colombia 14.
Coke and semicoke	881,084	699,016	655,314	East Germany 43,702
Peat including briquets and litter	value, thousands \$510	\$463	\$257	United Kingdom \$56; France \$49.
Petroleum:				
Crude	thousand 42-gallon barrels 124,175	134,092	6,276	United Kingdom 71,051; Venezuela 11,349; Nigeria 9,867.
Refinery products:				
Liquefied petroleum gas	value, thousands \$141,852	\$123,472	\$122,540	Netherlands \$759; West Germany \$83.
Gasoline, motor	do \$172,421	\$239,892	\$94,788	Netherlands \$28,833; United Kingdom \$26,341.
Mineral jelly and wax				
	thousand 42-gallon barrels 101	177	170	United Kingdom 4; France 2.
Kerosene and jet fuel	do. 12,441	11,463	5,576	U.S. Virgin Islands 1,727; Venezuela 1,532.
Distillate fuel oil	do. 5,055	3,777	2,811	Venezuela 441; Spain 244.
Lubricants	do. 4,082	6,887	2,611	Venezuela 1,486; Netherlands 830.
Residual fuel oil	do. 9,182	13,875	4,258	Venezuela 6,383; Gabon 754.
Bitumen and other residues	do. 1,045	1,193	829	Spain 186; Venezuela 178.
Petroleum coke	do. 5,175	5,303	5,209	Unspecified 94.

¹ Revised.

² Table prepared by H. D. Willis.

³ Energy, Mines and Resources Canada.

⁴ May include other precious metals.

from the higher prices. Mine production was 725,000 tons, and actual shipments totaled 713,000 tons.

Cominco Ltd.'s major Canadian copper-molybdenum mine is Highland Valley Copper (HVC) at Logan Lake, British Columbia, a partnership of Cominco Ltd. (50%), Rio Algom Ltd. (33.5%), Teck Corp. (11.5%), and Highmont Mining Co. (5%). In February 1988, HVC announced a \$70 million expenditure to expand the Lornex milling complex and relocate the two Highmont mills to a site adjacent to the

Lornex mill. HVC expected the current effective capacity of 91,000 tons to be increased to 131,000 tons per day by this expansion. The former Bethlehem Copper mill, part of the Lornex complex, currently producing 29,000 tons per day, will be placed on a standby basis once the expanded Lornex mill becomes fully operational. The Bethlehem mill will be maintained to supplement production, should market conditions warrant. Total ore processed at Lornex mill was 44,100,000 tons. Most of the copper concentrate was sold to

Japan under long-term contracts. The remaining concentrate was sold to other countries in Asia, Europe, and South America.

Noranda Inc. (60%) and BP Canada Inc. (40%) continued exploration of the Tally Pond joint venture in central Newfoundland. Drilling at yearend provided 4 million tons of ore at 3.5% copper, 6.6% zinc, 1.1% lead, 67.4 grams of silver per ton, and 1 gram of gold per ton; eventually, this could be an important feed source for Noranda's Murdochville, Quebec, copper smelter.

Noranda Inc. committed \$20 million to reopen its Murdochville Mine which closed in April 1987 because of an underground fire. At the Horne smelter, work started on the \$125 million acid plant, which should be completed by the end of 1989. Noranda initiated a tank-house modernization at its Montreal East copper refinery.

Minnova Inc.'s Lac Dufault Div. (Ansil Mine Project, Norbec Mill) continued development of its Ansil Mine in Quebec. Work continued with development of the upper part of the mine and the 1,460-meter level at the bottom of the mine. As of December 1988, about 10,000 tons of development ore were stockpiled at the Norbec Mill. Full production at 450,000 tons per year is expected to commence by mid-1990.

Geddes Resources Ltd.'s Windy Craggy copper, gold, silver, and cobalt property in the extreme northwest part of British Columbia is the largest copper deposit being explored in Canada. Drilling indicated resources are in excess of 90 million tons with 2% to 3.5% copper, plus gold, silver, and cobalt values. About 600 meters of the 1,800 meters of known underground mineralization have been proven. Exploration activity will continue in 1989.

Hudson Bay Mining & Smelting Co. Ltd. (HBM&S) of Manitoba proposed a \$130 million program to reduce SO₂ emissions and to modernize operations at its Flin Flon copper smelter. The company's Ruttan Mine was closed by a strike from June 1 to September 8, 1988. During this time, the Flin Flon smelter operated on purchased concentrates and production from the company's other mines.

Gold.—Gold prices trended downwards from \$480 per ounce in the early part of the year to slightly more than \$400 per ounce at yearend. The 1988 average price was about \$10 less than the 1987 average of \$497 per ounce.

At yearend, there were 61 primary gold mines operating in Canada, which accounted for about 80% of the annual

production of 127.7 tons of gold. Canadian proven and probable gold reserves, including operating mines, mines under development, and tailings, increased by 15% to 1,700 tons of gold.

Placer Dome Inc. (PDI) is one of the world's significant gold producers and was the leading gold producer in Canada. The company operated 12 gold mines out of 18; 13 mines are in Canada and the United States, and the others are in Australia, Papua New Guinea, and Chile. PDI has a production capacity of about 1 million ounces of gold annually.

PDI's Dona Lake Mine and mill at Pickle Lake, Ontario, with a capacity of 550 tons per day, were completed on schedule at a cost of \$43 million. Production will commence in February 1989 at an estimated production cost of \$244 per ounce of gold. Proven and probable reserves were 754,000 tons at 0.24 ounce per ton, plus 1.17 million tons at 0.17 ounce per ton at depth as a potential source of gold.

The Dome Mine in Timmins, Ontario, has a modern carbon-in-pulp recovery circuit, which was completed in 1988, and a 10% increase in capacity to 3,300 tons per day was achieved. The expected annual gold production will be about 133,000 ounces.

Houston Metals Corp. announced the discovery of more ore at the Silver Queen Mine, which is under development near Houston, British Columbia. Currently estimated reserves were 1.73 million tons at 0.09 ounce per ton of gold, 10.55 ounces per ton of silver, and 6.2% zinc with associated copper and lead values.

Canamax produced its first gold from the Kremzar Mine, 32 kilometers northeast of Wawa in Northern Ontario. The mine officially opened on October 4, 1988, and was expected to produce about 33,000 troy ounces of gold per year at an estimated cost of \$295 per ounce.

ERG Resources Inc. opened its \$78 million tailings project. The expected annual gold production will be 110,000

ounces. The new mill in Schumacher will process more than 200 million tons of tailings from the Timmins area, which can support 17 years of recovery operations.

Doyon Mine was Quebec's largest gold producer, accounting for 25% of gold output from the Province. Production in 1988 was 260,000 ounces compared with 248,000 ounces of gold in 1987. The partners, Cambior Inc. and Lac Minerals, invested \$74 million to bring the mine into production and \$21 million to expand the mill. An additional \$16 million expenditure was planned to boost underground production to 3,000 tons per day.

Iron Ore.—About 53% of Canadian iron ore was exported to Europe and Japan. Canada shares about 4% of world production and about 8% of world trade. Six iron ore mines operated in Canada, and production was estimated at 39.8 million tons. Canadian shipments of iron ore increased 2.3 million tons to 40.7 million tons, including shipments from stockpiles, at a value of \$1.4 billion. Exports exceeded 30 million tons, and Western Europe was the largest market for Canadian iron ore. The U.S. imported more than 9 million tons.

Iron Ore Co. of Canada (IOC) shipped about 37% of Canadian iron ore production. IOC and the Canada Centre for Mineral and Energy Technology (CANMET) entered into a joint venture to use their combined technology on magnetic and flotation concentration of iron ore to improve IOC's recovery of fine iron ore particles.

Quebec Cartier Mining Co. (QCM) sold about 16.8 million tons of pellets and concentrates. QCM produced products that are tailored to customer requirements. Main grades of pellets were acid, low silica, and self-fluxed. Pellet plant production exceeded 8 million tons.

Production from Wabush mines at Labrador, Newfoundland, was more than 6 million tons. Wabush offered three products; namely, acid pellets with 1% and

2% manganese and fluxed pellets with 1% manganese.

Dofasco Inc.'s two iron mines, in northern Ontario, Adams and Sherman, experienced labor strikes in 1988. The Adams concentrator and mine closed for 5 weeks in July and August, and the Sherman Mine stopped all operations for 5 weeks in the summer. As a result, production at Adams was less than 1 million tons and at Sherman less than 0.9 million tons.

Lead and Zinc.—The price of zinc at the beginning of 1988 averaged 39.8 cents per pound closing the year at 73 cents per pound. The LME High Grade (HG) price averaged 56.4 cents per pound. The LME lead price remained steady until late in 1988, when seasonally high battery demand and strikes in Peru resulted in a higher price. The price rose from 27.0 cents in 1987 to 29.7 cents per pound of lead in 1988.

Cominco Ltd.'s integrated smelter and refining complex at Trail, British Columbia, produced a wide range of metals, principally refined lead, zinc, silver, and gold. Annual effective capacity was 122,500 tons of refined lead and 272,200 tons of refined zinc. More than 50% of Cominco's lead and zinc concentrates were refined at Trail. Refined lead production was 120,100 tons. Refined zinc production was 283,400 tons. Production was affected by a 17-week labor strike in Canada.

Cominco's Sullivan Mine at Kimberley, British Columbia, was the main supplier of lead and zinc concentrates to Trail. Mill feed increased by 61%, the second highest level in more than 20 years.

A joint venture between Cominco (55%) and Pine Point Mines Ltd. (45%) operated the Polaris lead-zinc mine at Little Cornwallis Island, Northwest Territories. This mine was the Western World's most northerly base metals operation. Concentrates were shipped to European smelters during a 10-week period in the summer, when shipping channels were open for navigation. The facil-

ity, which went into production in March 1982, is internationally recognized for its modern mining and milling technologies in permafrost operation. The Polaris Mill treated a record 1,016,000 tons of ore. Ore reserves at yearend amounted to 14 million tons. Exploration in the mine area will recommence in 1989.

HBM&S began development of its Callinan zinc and copper deposit in northern Manitoba and expansion of its Chisel Lake lead and zinc mine in Manitoba.

Nickel.—This commodity had an impressive performance in 1988. Costs were reduced from \$1.97 per pound in 1984 to \$1.41 in 1988. In 1988, the LME averaged \$6.28 per pound of nickel, an increase of \$4.07 per pound of nickel from 1987. The stainless steel industry worldwide consumed 55% of the nickel produced. Major nickel consumers were Japan, the United States, and Western Europe, which accounted for 90% of nickel demand. The demand for nickel in the Western World increased by about 13,000 tons.

Inco Ltd. and Falconbridge Ltd. had major corporate developments. Inco implemented a recapitalization process of more than \$1.2 billion, which included a special dividend of \$10 per share to shareholders to avoid unfriendly takeover. Noranda Inc. acquired a 19.6% interest in Falconbridge to become its largest shareholder.

Sulfur dioxide containment programs were announced by Inco and Falconbridge to comply with Ontario's regulations, effective in 1994.

Inco announced a \$454 million capital investment program. Falconbridge will spend \$38 million on research, development, and capital requirements to increase pyrrhotite rejection and roasting capacity to minimize SO₂ emissions. Inco announced that it would proceed with the \$100 million development of the Thompson south open pit and reactivation of the Birchtree Mine. Falconbridge plans to spend \$33 million at its underground Lindsley project near Sudbury,

the development of which is expected to be completed in 1991.

Sherritt Gordon Ltd. produced 24,000 tons of nickel in briquets and powder at its Fort Saskatchewan, Alberta, refinery. HBM&S (60%) and Outokumpu Mines Ltd. (40%), owners of the Name Lake nickel mine, about 40 miles south of Flin Flon in Manitoba, developed the \$70 million project to produce 9,200 tons of nickel in concentrate and 3,500 tons of copper in concentrate annually. Known reserves were 2.6 million tons at 2.44% nickel and 0.9% copper.

Silver.—Average silver prices decreased to \$6.51 per ounce. Production of most of Canada's silver was as a byproduct of base metals. In Ontario, the largest silver-producing Province, output declined by 5% to 14.6 million ounces partly because of the decline in production of base metals.

Agnico Eagle Mines Ltd., Canada's only primary silver producer, operated three silver mines in the cobalt area of eastern Ontario. The company's refinery produced about 1.3 million ounces of silver.

Other Metals.—The strong performance of cadmium, at \$6.94 per pound, reflected the unprecedented growth in demand for nickel-cadmium batteries in the consumer goods market. Cominco announced the construction of a new indium plant at its British Columbia Trail facility, by which the company expected to increase production capacity to 1 million ounces per year.

Rio Algom Ltd.'s subsidiary, Rio Kemptville Tin Corp., owns and operates the East Kemptville open pit and concentrator near Yarmouth, Nova Scotia. These facilities were reacquired on March 1, 1988. East Kemptville processed 2.7 million tons of ore to produce 5,700 tons of tin concentrate containing 55.9% tin with minor values of copper and zinc. Proven and probable tin reserves at yearend were 36.4 million tons at 0.175% tin, 0.10% cop-

per, and 0.18% zinc.

In 1986, low tungsten prices had forced the closure of Canada Tungsten Mining Corp. Ltd.'s Cantung Mine in the Northwest Territories. Continuing low prices for tungsten led to the shutdown of the mine during 1988. Carbovan Inc. began building a plant in Alberta to recover approximately 1,000 tons per year of vanadium oxide from fly ash derived from Athabasca tarsands. Construction completion was expected in late 1989.

After a lapse of 6 years, Tantalum Mining Corp. of Canada Ltd. (Tanco) resumed in August production of tantalum at its Bernic Lake lithium-tantalum-cesium mine in Manitoba. Highwood Resources Ltd. and Hecla Mining Co. of Canada Ltd. planned to evaluate the Lake Zone deposit of the Thor Lake rare metals project about 100 kilometers southeast of Yellowknife, Northwest Territories. Canadian molybdenum production decreased to 12,388 metric tons, and production value decreased to \$108 million. The five molybdenum producers were Placer Dome Inc., Brenda Mines Ltd., Highland Valley Copper, Utah Mines Ltd., and Gibraltar Mines Ltd. The Endako Mine of Placer Dome Inc., Canada's only primary molybdenum producer, operated at capacity since October 1988. Canada was the third largest cobalt producer in the world; about 90% of production was exported. Cobalt from Canadian sources was recovered as a byproduct of nickel refining by Inco at Port Colborne, Ontario; Sherrit Gordon Ltd. in Fort Saskatchewan, Alberta; and Falconbridge in Norway.

Industrial Minerals

Asbestos.—Canadian production of asbestos fiber, despite health concerns about asbestos, increased almost 8%. Developing countries consumed an estimated 42% of Canada's output. The balance was consumed by Japan, the United States, and Western Europe. Total sales were 705,000 tons valued at \$268 million.

Cliff Resources of Toronto acquired controlling interest in Baie Verte Mines (BVM) of Newfoundland. The firm was constructing a wet-milling process, which will allow secondary recovery of short asbestos fibers from tailings. BVM ore reserves neared depletion, but this new process was expected to extend the life of BVM by about 13 years.

Cassiar Mining Corp. negotiated a \$25 million development loan from the British Columbia government to finance the \$43 million development of the underground McDame asbestos deposit. Mine development started in 1988.

Potash.—The value of potash output increased sharply to \$889 million, a gain of almost 50%. Canada produced 8.3 million tons.

Potash Corp. of Saskatchewan (PCS) made a dramatic comeback to profitability, with net profit of more than \$100 million after a \$21 million loss in 1987 and a \$104 million loss in 1986. PCS produced about 5 million tons of potash. PCS indicated that productivity increased by 15% to 20% at each of its five potash mines.

Cominco's potash operations near Vanscoy, Saskatchewan, completed a very successful year as a result of improved productivity, record sales, and higher prices. Production increased by 14.5%.

Noranda's Central Canada Potash subsidiary produced 1.1 million tons of potash.

Potash Company of America (PCA), a subsidiary of Rio Algom, was a major Canadian producer of potash for use in fertilizers. PCA operated its mining and processing facilities at Sussex Mine in Sussex, New Brunswick, and at Saskatoon Mine in Saskatoon, Saskatchewan. The Sussex facilities operated at 87% capacity to produce 608,000 tons of potash. At the Saskatoon Mine, which ceased production in 1987 because of mine flooding, work resumed in August 1988 under a \$23 million program to produce potash by solution mining. Overall, utilization of capacity was 73%

compared with 66% in 1987. It was expected that full capacity could be reached by the mid-1990's to produce more than 700,000 tons of potash.

Other Industrial Minerals.—Cominco Fertilizers produced three main nutrients for agriculture usage: nitrogen, phosphates, and potash. The principal commercial products were anhydrous ammonia, ammonium nitrate, ammonium sulfate, potash, and urea. Cominco also produced sulfur in the form of sulfur dioxide as a byproduct of metal smelting. Most of the sulfur dioxide was converted to sulfuric acid, which was then used to process phosphate rock into fertilizer-grade phosphate compounds.

Brunswick Mining and Smelting Corp. produced about 137,400 tons of diammonium phosphate (DAP) at its New Brunswick fertilizer plant, from phosphate rock imported from Florida.

Silica shipments increased in Quebec, Manitoba, and British Columbia, and decreased in Ontario and Newfoundland. Consumption of foundry sand and silica sand used in the silicon carbide industry increased because the iron, steel, and base metal industries increased their activity.

Canada's shipments of all types of salt increased by 8% to about 11 million tons of which 63% was from Ontario. Production of salt was 9% higher than in 1987 or 11.1 million tons because of high operating levels, particularly in New Brunswick, Ontario, and Quebec. Canadian Salt Co. Ltd. continued development of a new mining level at its Pugwash property in Nova Scotia. The development is expected to be completed in 1990. A new brine evaporator was installed to improve recovery. At Sarnia, Ontario, workers at Dow Chemicals Canada Inc. ended a 7-month strike in late November 1988 after negotiating a 2-year contract.

Canadian cement production capacity decreased to 14.8 million tons per year. Given the strong demand in 1988, imports of both clinker and cement

increased.

St. Mary's Cement planned to double production capacity at Bowmanville, Ontario, by mid-1991 at a cost of \$160 million. St. Lawrence Cement Inc. began work at its Mississauga, Ontario, facility on a \$13.5 million kiln modification to reduce production costs.

Domtar Inc. began developing a new underground gypsum mine adjacent to its Caledonia complex in Ontario at a cost of \$13 million. Full production was expected to begin in early 1990.

Newfoundland Resources & Mining Co. Ltd. continued development of its limestone aggregate operation at Port Peninsula, Newfoundland.

Mineral Fuels

Coal.—Demand in the worldwide steam coal market strengthened in the second half of 1988 because electricity use grew. However, low prices more than offset that favorable trend. Canada's record coal production was attributed to high exports to Japan and Korea. Canadian coal production increased to a record 69.5 million tons. Exports reached an alltime high of 31.5 million tons.

The dollar value of coal output increased to \$1.6 billion in 1988, a 14.3% gain. Canada exported almost 21% more coal to Japan or 15.7 million tons, and sustained a 26% share of the Japanese market. The Coal Association of Canada estimated that total coal output was composed of 58.7% thermal coal and 41.3% of metallurgical coal.

Teck Corp.'s Bullmoose open pit coal and processing facilities are in northwestern British Columbia about 30 kilometers northwest of Tumbler Ridge. More than 2 million tons of coal were processed there, resulting in the recovery of 1.7 million tons of metallurgical coal.

Gulf Canada Corp. shipped test quantities of anthracite from the Mount Klappan Mine, in the northwestern part of the Groundhog coalfield of Interment-

ane, British Columbia, to Korea and Western Europe with favorable results. The mine estimated coal reserves of 6 billion tons. Relatively large-scale mining operations were being considered.

Natural Gas.—The value of natural gas produced increased to \$5.3 billion. The soaring demand for natural gas created a rebound in pipeline construction activity.

Gulf Canada and partners applied for a license from the Canadian Government to export 3.2 trillion cubic feet of gas for 20 years. Most of the gas will come from the Parsons Lake field in the Mackenzie Delta and Amauligak field in the Beaufort Sea.

Petroleum.—Lower prices of crude oil continued to affect petroleum exploration and development activities in Canada. Despite a 4.2% increase in crude oil production, price reductions forced a 17.4% decline in the value of crude oil produced to \$7.6 billion.

A consortium of Esso Resources Canada Ltd. (25%), Canadian Occidental Petroleum Ltd. (20%), Gulf Canada Resources Ltd. (20%), Petro-Canada Inc. (15%), Pan-Canadian Petroleum Ltd. (10%), and Alberta Oil Sands Equity (10%), signed a statement of principles with the Governments of Canada and Alberta to proceed with the development of a massive oil sand, called the Other Six Leases Operation (OSLO), about 80 miles north of Fort McMurray in northeast Alberta. OSLO will cost \$3.5 billion, and production at 77,000 barrels of oil per day was expected to start in 1996. Lease 31, among the six OSLO leases, covers 75 square miles and contains an estimated 3.5 billion barrels of bitumen. Bitumen is a tarlike substance that contains the hydrocarbons that are processed into light crude oil.

The Canadian Government also approved two other large oil projects, the \$4.4 billion Hibernia Oilfield development off Canada's east coast and the \$1.1 billion heavy-oil upgrader near

Lloydminster on the western edges of Saskatchewan. Canada provided substantial financial aid to each of the OSLO, Hibernia, and Lloydminster projects.

The Athabasca oilsands, which includes OSLO, and the two other oil ventures, Hibernia and Lloydminster, contained an estimated 900 billion barrels of bitumen. This was equivalent to five times the proven crude oil reserves of Saudi Arabia.

Uranium.—Canada, with uranium mines in Saskatchewan and Ontario, produced about one-third of the world's supply.

The Canadian Mining and Energy Corp. (Cameco) of Saskatoon, Saskatchewan, was formed in October 1988 through the merger of provincially owned Saskatchewan Mining Development Corp. (61.5%) and federally owned Eldorado Nuclear Ltd. (38.5%). Both partners agreed to go public by selling 30% of Cameco in 1990, 30% in 1992, and 40% in 1995. Cameco's \$1.26 billion of assets and almost 500 million pounds of uranium ore reserves made it the "Saudi Arabia" of the uranium industry worldwide. Cameco's largest asset was its 49% share of Cigar Lake's uranium deposit, which contained 14% of uranium oxide or 280 pounds of U_3O_8 per ton of ore. Cameco planned to go into production by 1993.

¹ For more detailed information on the mineral industry, see the Canadian Mineral Surveys for 1985 and 1986, both of which were prepared by the Mineral Policy Sector and the Energy Sector, Department of Energy, Mines and Resources, Ottawa, Canada. The U.S. Department of the Interior, Bureau of Mines, has arranged to have these Canadian publications placed in libraries in each of the 50 States and Puerto Rico as follows: University of Alabama, Tuscaloosa; E.E. Rasmuson Library, University of Alaska, Fairbanks; University of Arizona, Tucson; University of Arkansas, Fayetteville; California State Library, Sacramento; A. Lakes Library, Colorado School of Mines, Golden; Wilbur Cross Library, University of Connecticut, Storrs; H. M. Morris Library, University of Delaware, Newark; S. Rozier Library, Florida State Library, Tallahassee; P. Gilbert Memorial Library, Georgia Institute of Technology, Atlanta; University of Hawaii, Hilo; University of

Idaho, Moscow; Morris Library, Southern Illinois University, Carbondale; Indiana University, Bloomington; Iowa State University of Science and Technology, Ames; Watson Library, University of Kansas, Lawrence; M. L. King Library, University of Kentucky, Lexington; University of Southwestern Louisiana, Lafayette; R. H. Folger Library, University of Maine, Orono; M.S. Eisenhower Library, Johns Hopkins University, Baltimore, MD; Massachusetts Institute of Technology Library, Cambridge; Michigan Technical Library, Houghton; Wilson Library, University of Minnesota, Minneapolis; University of Southern Mississippi, Hattiesburg; Rolla Library, University of Missouri, Rolla; Montana College of Mineral Science and Technology,

Butte; D.L. Love Library, Nebraska Geological Survey at University of Nebraska, Lincoln; University of Nevada, Reno; University of New Hampshire, Durham; J.C. Dana Library, Rutgers University, Newark, NJ; New Mexico Institute of Mining and Technology, Socorro; Columbia University, New York NY; D.H. Hill Library, University of North Dakota, Grand Forks; Ohio State University, Columbus; University of Oklahoma, Norman; Multnomah County Library, Portland, OR; Pennsylvania State University, University Park; University of Rhode Island, Kingston; Thomas Cooper Library, University of South Carolina, Columbia; South Dakota School of Mines and Technology, Rapid City; Tennessee State Library and Archives, Nashville; Main

Library, University of Texas, Austin; Marriott Library, University of Utah, Salt Lake City; Bailey Library, University of Vermont, Burlington; Virginia Polytechnic Institute, Blacksburg; University of Washington, Seattle; West Virginia University, Morgantown; Memorial Library, University of Wisconsin, Madison; University of Wyoming, Laramie; and University of Puerto Rico, Mayaguez.

² Physical scientist, Division of International Minerals.

³ Where necessary, values have been converted from Canadian dollars (CAN\$) to U.S. dollars at the rate of CAN\$1.3260 = US\$1.00 for 1987 and CAN\$1.2307 = US\$1.00 for 1988.